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ABSTRACT

This analytical report was developed from existing statistical data to illuminate the role of women and minorities in science and engineering. Two issues are addressed: whether there is a problem related to the employment of women in these fields, and whether women and minorities are underutilized in these fields. Sections of the first part of the report discuss the size of the science and engineering population and the amount of participation, employment data, unemployment rates, salaries, and conclusions. The second section discusses utilization in terms of abilities, science majors, transition from school to work, trends, and conclusions. Future prospects are also discussed briefly. (MS)

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WOMEN AND MINORITIES IN SCIENCE AND ENGINEERING

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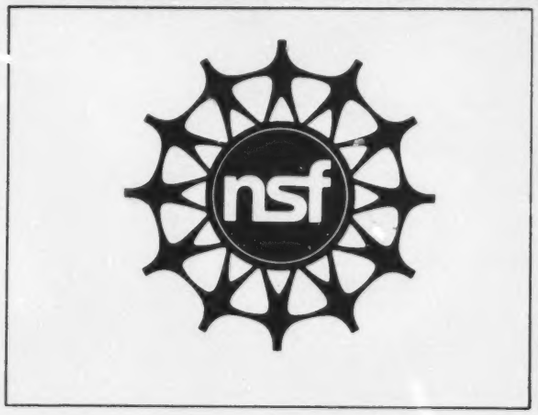
WOMEN AND MINORITIES IN SCIENCE AND ENGINEERING



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FOREWORD

In recent years, an increasing number of women have been professionally employed outside the home and in occupations once regarded as almost the exclusive domain of males. Likewise, members of racial minority groups have been entering professional occupations at a notably greater rate than in earlier years. In 1965, for example, 6.9 percent of employed minorities were in professional and technical occupations, but by 1975 this proportion had risen to 11.4 percent. During the same interval the proportion of whites in professional and related occupations increased from 13.2 percent to 15.5 percent.

Examination of the changing roles of women and minorities in science and engineering is receiving increasing attention. Discussion of this topic raises many questions, most prominent of which are those relating to the labor market experience—employment, unemployment, salaries, etc.—and the utilization of these segments of the population from a human resources point of view. Effective policy planning related to these issues requires good factual information. Consequently, the National Science Foundation is developing a continuously improving statistical data base on this component of the technical human resources system.

This analytical report was developed from existing statistical data to illuminate the role of women and minorities in science and engineering.

It was prepared in the Division of Science Resources Studies by Michael F. Crowley under the general direction of Robert R. Trumble, Head, Manpower Studies Section. That portion of the report concerned with the extent of utilization of women and minorities in science and engineering draws heavily from a paper developed by Naomi A. Sulkin in the Science Education Studies Group.

Charles E. Falk
Director
Division of Science Resources Studies

January 1977

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HIGHLIGHTS

- About 96,000 women were employed as scientists and engineers in 1974. These women represented 6 percent of the total number—1.7 million—of employed scientists and engineers in the United States.

- Almost one-half (89,000 out of 185,000) of all female scientists and engineers were not employed and were not seeking employment. Only 12 percent (222,000 out of almost 1.8 million) of the male scientists and engineers were not in the labor force in 1974.

- About 5 percent of all employed scientists and engineers of both sexes in 1974—79,000—were members of racial minority groups.

- Women constituted 7.6 percent (17,300) of the employed doctoral scientists and engineers in 1973, and represented 8.7 percent of all doctoral scientists and engineers.

- Asians of both sexes made up the largest racial minority group among employed doctoral scientists and engineers, representing almost 5 percent of the total. Blacks of both sexes constituted less than 1 percent of the total employed, and other minorities represented even smaller proportions.

- The unemployment rate (those not employed but seeking employment) for female scientists and engineers was about 2 percent in 1974. For males the rate was about 1 percent.

- Among minority scientists and engineers, the unemployment rate was less than 1 percent.

- Women scientists and engineers had lower annual salaries than males in 1974. The median annual salary for males was $19,400; for women it was $15,700.

- Among doctoral scientists and engineers, women had lower overall salaries than men in 1973—$17,600 for women and $21,200 for men.

- Asian and other racial minorities generally had lower salaries than White or Black scientists and engineers at the doctoral level.

- The gap in starting salaries for women scientists and engineers is narrowing. For example, the average offer at the B.S. level to men in the biological sciences was $9,600 per year in 1975, 6.5 percent above 1974. For women, the average offer in 1975 was $8,832, an increase of almost 11 percent over 1974.

- The lack of women in science is not due to a failure to develop the requisite background skills prior to and during high school.

- Minorities, however, appear not to have developed those background skills needed for science activities by the time they complete high school.

- In 1974 women earned 30 percent of the bachelor's degrees awarded in science and engineering, and in 1975 women earned 16 percent of all science and engineering doctorates.

- The proportion of doctor's degrees in science and engineering earned by Whites increased between 1974 and 1975.

- Only 18 percent of the women who earned a bachelor's degree and expressed a desire for a career in science or engineering in 1965 were engaged in their chosen career 6 years later; the comparable figure for men was about 50 percent.

INTRODUCTION

This report focuses on two separate but intertwined issues. The first issue is concerned with whether there is a problem or series of problems related to the employment of women and minorities in the scientific[1] and engineering (S/E) workforce. The analysis of this issue revolves around labor market indicators—labor force participation, employment, unemployment, and salaries.[2] The second issue is concerned with whether there is an underutilization of women and minorities as a human resource in science and engineering, and, if so, to what extent, and why. The issue of underutilization is addressed by looking at science abilities and potential; early career choices; participation in science studies at the college and university level; and the transition from school to employment in the S/E labor force.

In addressing these issues, it was extremely difficult to determine causal relationships. However, data are presented throughout this report that provide insights and a greater understanding of the issues. For example, data indicate that the science potential for both males and females in high school is about equal, but that relatively few women enter careers in science. While these types of data help define an issue and pinpoint specific problem areas, they do not necessarily explain the causes of the problem.

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[1] Science includes the physical, life, social, and mathematical sciences. Excluded are those medical practitioners, such as dentists, engaged in patient care, nurses, etc.

[2] The data in this report on employment, labor force participation, etc., include information on non-U.S. citizens as well as citizens. Since some noncitizens may be members of racial minority groups, the data presented may, to some extent, have the effect of overstating the participation of American-born minorities in the S/E labor force. Data pertaining only to U.S. citizens is so noted in the text.

Part I

WOMEN AND MINORITIES IN THE SCIENTIFIC AND ENGINEERING WORKFORCE

Size of the Science and Engineering Population—Labor Force Participation

ALL SCIENTISTS AND ENGINEERS

There were approximately 2 million scientists and engineers in the United States in 1974. About 185,000 (9.4 percent) were women. More than 9 of every 10 women were scientists rather than engineers. Only 4 of every 10 men, however, were scientists. The concentration of women in science rather than engineering seems to reflect, to some extent, occupational stereotyping, both on the part of society and on the part of women themselves.

Almost one-half of all female scientists and engineers (47 percent) were not in the labor force in 1974; that is, they were "not employed and were not seeking employment." In contrast, approximately 12 percent of the male scientists were not in the labor force in 1974.

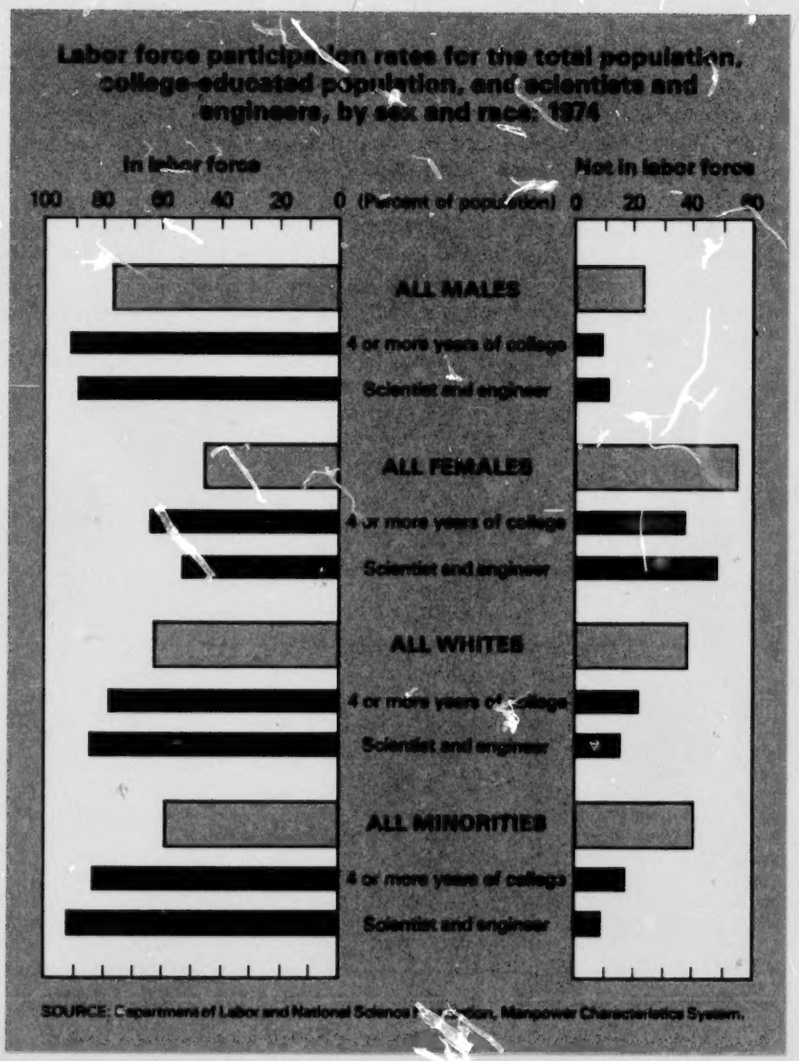
The participation of both male and female scientists and engineers in the labor force differs somewhat from the labor force participation of the general population. For example, for the general population, about 55 percent of the females were not in the labor force, as were almost 24 percent of the men. The greater participation of all scientists and engineers in the labor force is at least partially explained by the slightly older S/E population and their higher levels of education. Labor force participation generally increases, to a point, with age and educational attainment.

It may seem surprising that the S/E labor force participation of scientists and engineers of both sexes was less than that for those in the general population who have completed 4 or more years of college. In 1974, 36.5 percent of the females who had completed 4 or more years of college were not in the labor force, as were 9 percent of the males.

Scientists and engineers by field, sex, and race: 1974

Field	Total	Sex		Race				
		Male	Female	White	Black	American Indian	Asian	Other
Total	1,973,000	1,788,000	185,000	1,886,000	31,700	1,800	36,500	17,000
Physical scientists	188,000	170,000	18,000	179,000	3,500	(1)	4,600	1,300
Mathematical scientists	60,000	45,200	15,000	57,000	1,900	(1)	1,300	(1)
Computer specialists	125,000	101,000	24,000	120,000	2,500	(1)	1,300	700
Environmental scientists	52,000	49,000	3,000	51,000	100	(1)	500	(1)
Engineers	1,072,000	1,064,000	8,000	1,035,000	8,500	500	20,200	8,100
Life scientists	194,000	160,000	34,000	184,000	3,500	(1)	2,700	3,300
Psychologists	95,000	68,000	27,000	90,000	1,600	(1)	2,600	600
Social scientists	187,000	131,000	56,000	172,000	10,200	500	2,200	2,100

[1] Less than 500.
Note: Detail may not add to total because of rounding.
Source: National Science Foundation, Manpower Characteristics System.


Labor force participation rates for the total population, college-educated population, and scientists and engineers, by sex and race: 1974
In labor force
Not in labor force
100 80 60 40 20 0 (Percent of population) 0 20 40 60
ALL MALES
4 or more years of college
Scientist and engineer
ALL FEMALES
4 or more years of college
Scientist and engineer
ALL WHITES
4 or more years of college
Scientist and engineer
ALL MINORITIES
4 or more years of college
Scientist and engineer
SOURCE: Departments of Labor and National Science Foundation, Manpower Characteristics System.

Several hypotheses could be explored to help explain the above data: scientists and engineers may, on the average, be older than the general population with 4 or more years of college, and hence, more may be retired; relatively more scientists and engineers may be out of the labor force because they are going to school on a full-time basis; or the "low" labor force participation of scientists and engineers may reflect particular definitions used by NSF in defining this population.[3]

The reasons for scientists and engineers not being in the labor force differ considerably between men and women and generally reflect traditional societal roles assigned men and women. Of those female scientists and engineers not in the labor force, only about 20 percent were retired. The remainder were out of the labor force for "other reasons," such as family responsibilities, ill health, etc. These "other reasons" also may reflect past discrimination against women in science and engineering. In contrast, about 80 percent of the male scientists and engineers not in the labor force in 1974 were retired.[4]

Less than 5 percent of all scientists and engineers of both sexes in 1974—87,000—were members of racial minority groups. Of these, about one in five were women. Among White scientists and engineers, about 1 in 10 were women.

Members of minority groups who are scientists and engineers were more likely than their White counterparts to be in the labor force. Thus, about 15 percent of the White scientists and engineers were not in the labor force in 1974, compared to only about 8.5 percent of the minority group members. The higher labor force participation rate for minority group scientists and engineers is somewhat surprising since the proportion of women among minority group scientists and engineers is about twice that for Whites and 47 percent of all women scientists and engineers are not in the labor force. The high labor force participation rate for minorities may reflect more favorable career opportunities for minority group scientists and engineers vis-a-vis minorities in the general population because of equal employment and affirmative-action legislation. Also, given historical patterns of discrimination, it may reflect a greater commitment to gainful employment in science and engineering among minority group scientists and engineers.

[3] See technical notes.

[4] National Science Foundation, *Characteristics of the National Sample of Scientists and Engineers, 1974. Part 2. Employment* (NSF 76-323) (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1977).

As would be expected, because of average age and education, the labor force participation for both White and minority group scientists and engineers are considerably above the rates for the general population. The relatively large proportion of the general population 16 years of age and older not in the labor force reflects, in addition to the relatively large number of women, a large number of full-time students.

About 70 percent of the White scientists and engineers not in the labor force in 1974 were retired, while only 22 percent of those belonging to the racial minority group were retired, according to data developed as part of the National Sample[5] of scientists and engineers. This reflects to some extent, the relatively fewer numbers of minority group scientists and engineers who are 55 years of age or older.

DOCTORAL SCIENTISTS AND ENGINEERS

Women constituted 8.7 percent of the doctoral scientists and engineers in 1973. Most (86 percent) women doctoral scientists and engineers were White. Of the remainder, Asians outnumbered Blacks by more than 3 to 1. The representation of women in different fields varied considerably. Of all women scientists and engineers with a doctorate, over 36 percent were in life sciences (primarily biological) and another 27 percent were in psychology. Again, these distributions may reflect society's "traditional" expectations for women. For example, biological sciences may be viewed by the general public as "health" related, and "health" along with psychology may be viewed as "helping" occupations. Following from women's traditional roles as wives and mothers, women might be encouraged, pressured, etc., into "helping" fields. The distributions may also reflect limited opportunities for women in the physical sciences.

[5] See technical notes.

Asians of both sexes make up the largest racial minority group among doctoral scientists and engineers, representing 4.5 percent of the total. Blacks of both sexes constitute less than 1 percent of the total, and other minorities represent even smaller proportions.

About 15 percent of the women with Ph.D.'s in science and engineering were not in the labor force in 1973. For men, the comparable rate was 5.5 percent. Among racial minorities, 9 percent of those holding the Ph.D. in science and engineering were not in the labor force, slightly higher than the 8.5 percent average for the S/E population who were members of racial minority groups.[6]

[6] Based on data contained in the Manpower Characteristics System, National Science Foundation.

Women and minority doctoral scientists and engineers by field: 1973

Field	Total	Women	Minorities (both sexes)				
			Black	American Indian	Asian	Other	No report
Total	244,900	21,300	1,900	100	11,000	300	19,000
Physical scientists	53,400	2,400	400	(1)	2,500	100	4,000
Mathematical scientists	13,500	1,000	100	—	700	(1)	1,200
Computer specialists	2,900	100	(1)	—	100	(1)	300
Environmental scientists	11,100	300	(1)	—	300	(1)	700
Engineers	37,400	200	100	(1)	3,100	100	2,200
Life scientists	65,500	7,700	600	(1)	2,800	100	4,700
Psychologists	28,300	5,800	200	(1)	300	(1)	2,700
Social scientists	32,800	3,600	400	(1)	1,200	(1)	2,900
No report	800	200	(1)	—	(1)	—	200

[1] Less than 50.
Note: Detail may not add to totals because of rounding.
Source: National Science Foundation, Manpower Characteristics System.

Employment of Scientists and Engineers

The number of females employed as scientists and engineers in 1974—96,000—represented about 6 percent of all employed scientists and engineers. Among female scientists and engineers, the largest proportion (22 percent) were computer specialists. It is interesting to note that about 88 percent of the female computer specialists in the S/E population were employed. By way of contrast, only 53 percent of the life scientists and 23 percent of the social scientists were employed. This relatively high ratio between the number of female computer specialists in the population and their employment as computer specialists may reflect the more favorable employment opportunities for the computer specialist—a relatively new occupation which has grown so rapidly that demand frequently exceeded supply. Since traditional barriers to employment tend to fall in the face of a skill shortage, women may have found employment as computer specialists because they had the educational background and were available for employment.

The employment of female scientists and engineers as computer specialists is generally consistent with the data presented in the section on the transition of scientists and engineers from school to work (p. 16). Those data indicate that most of the women who planned careers (and hold degrees) in the natural sciences and who do not work as natural scientists work in the computer field.

The total number of minorities employed as scientists and engineers in 1974 was about 79,000 (5 percent of the total). Of these, 42 percent were Asians and 37 percent were Black.

Employment of scientists and engineers, by sex and race: 1974

Field	Total	Sex		White	Total minorities	Black	American Indian	Asians	Other
		Male	Female						
Total	1,662,000	1,566,000	96,000	1,583,000	79,000	30,000	1,600	33,000	15,000
Physical scientists	156,000	141,000	14,000	147,000	8,000	3,000	(1)	4,000	1,000
Mathematical scientists	45,000	38,000	7,000	42,000	3,000	1,500	(1)	1,000	(1)
Computer specialists	122,000	101,000	21,000	116,000	5,000	2,000	(1)	2,000	600
Environmental scientists	44,000	42,000	1,800	43,000	1,000	(1)	(1)	(1)	(1)
Engineers	999,000	993,000	5,000	963,000	29,000	8,000	(1)	20,000	8,000
Life scientists	136,000	118,000	18,000	129,000	7,000	3,000	(1)	2,000	2,000
Psychologists	61,000	46,000	15,000	57,000	4,000	1,000	(1)	2,000	500
Social scientists	100,000	87,000	13,000	86,000	14,000	10,000	500	2,000	2,000

[1] Less than 500.
Note: Detail may not add to totals because of rounding.
Source: National Science Foundation, Manpower Characteristics System.

The occupational (fields of science) distribution of minority scientists and engineers was significantly different than that for Whites; for example, 36 percent of the minority group were engineers, compared to 60 percent of the White scientists and engineers. Among science fields, the largest number of minority group members were employed as social scientists (18 percent). Among minority groups' social scientists, about 7 of every 10 were Black. Only 5 percent of the White scientists were employed as social scientists.

In 1974 women constituted almost 40 percent of the employed labor force,[7] but only about 6 percent of the employed scientists and engineers. Minorities represented nearly 11 percent of all employed persons, but only about 5 percent of those employed as scientists and engineers.

Of the 227,000 employed doctoral scientists and engineers, 17,000 or 7.6 percent, were women. The largest number of employed women were life scientists, followed by psychologists and social scientists.[8]

Among the employed doctoral scientists and engineers in 1973, relatively more women than men were employed in nonscience jobs and were employed on a part-time basis. For example, about 7 percent of the women were in nonscience jobs as were 5 percent of the men. Almost 16 percent of the employed women were working part time, compared to only 2 percent of the men. The amount of voluntary nonscience and part-time employment among women is unknown, however.

[7] Executive Office of the President, *Employment and Training Report of the President* (Incl. Reports by the U.S. Department of Labor and the U.S. Department of Health, Education, and Welfare). Transmitted to the Congress 1976. (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office.)

[8] Data on the characteristics of doctoral scientists and engineers in 1975 were received by the Foundation subsequent to the development of this report. In 1975, about 22,500 female doctoral scientists and engineers were employed, representing about 8.6 percent of the total number of employed doctoral scientists and engineers.

Asians constituted the largest proportion among doctoral scientists and engineers who are members of racial minorities groups. In 1973, over 80 percent were Asians, with Blacks accounting for approximately 13 percent.

Are there indications that women and minority scientific and technical personnel face labor market problems different from those faced by the overall scientific and technical workforce? Besides labor force participation, two statistical indicators of potential labor market problems are unemployment rates and salary levels. These indicators suggest possible areas of concern by helping to define the dimensions of problems and assist in the development of policy options to overcome difficulties.

Employed women and minority doctoral scientists and engineers by field: 1973

Field	Total	Women	Minorities (both sexes)				
			Black	American Indian	Asian	Other	No report
Total	226,750	17,300	1,700	100	10,450	300	16,250
Physical scientists	49,100	1,900	400	(1)	2,350	50	3,400
Mathematical scientists	12,600	800	100	—	650	(1)	1,100
Computer specialists	2,900	100	50	—	100	(1)	250
Environmental scientists	10,550	250	(1)	—	300	—	800
Engineers	36,200	150	100	(1)	3,100	50	2,050
Life scientists	59,350	6,100	550	(1)	2,600	100	4,000
Psychologists	26,050	5,000	200	(1)	300	(1)	2,250
Social scientists	29,850	3,000	300	50	1,100	50	2,400
No report	150	(1)	(1)	—	(1)	—	(1)

[1] Less than 50.

Note: Detail may not add to total because of rounding.

Source: National Science Foundation, Manpower Characteristics System.

Unemployment Rates

Data developed by the National Science Foundation have a fairly high degree of statistical reliability (relatively low standard or sampling errors) and indicate that the unemployment rate for male scientists and engineers in 1974 was about 1 percent and that the rate for female scientists and engineers approached 2 percent. [Among minorities the unemployment rate was less than 1 percent.] The error range associated with the estimated unemployment rate for males is ± 0.05 percent. For females, the estimated error range is ± 0.25 percent.[9]

Considerably more detailed data are available on unemployment among women and minority doctoral scientists and engineers. The overall unemployment rate for male doctoral scientists and engineers in 1973 (less than 1 percent) was about the same as that for male scientists and engineers, regardless of degree, and considerably below the unemployment rate for all males in the economy (4.1 percent in 1973). For women doctorates, the unemployment rate was 3.9 percent[10] (±0.2 percent at one standard error), and among racial minority doctorate groups of both sexes it was about 1.6 percent.[11] Among the general population, the unemployment rate for women was 6.0 percent, among minorities it was 8.9 percent.[12] About 80 percent of the unemployed women doctoral scientists and engineers were White; another 13 percent were Asians. No unemployment was reported for Black females. About 270 of the approximately 700 unemployed female doctoral scientists and engineers of all races in 1973 were life scientists, representing a 4.3-percent unemployment rate. Physical scientists reported the highest unemployment rate (7.3 percent), while there was no reported unemployment among female doctoral computer specialists. Among the other major fields of employment, mathematical, environmental, and social scientists, and psychologists reported below-average unemployment rates, while engineers showed an above-average unemployment rate. With the exception of computer specialists, however, the reported unemployment rates in major occupational fields for females were well above the average for all male doctoral scientists and engineers.[13]

Unemployment rates for doctoral scientists and engineers, by sex and race: 1973

Sex and race	Unemployment		
	Number	Rate	Standard error (Percent)
Total	2,600	1.2	0.05
Sex:			
Men	1,900	.9	.05
Women	700	3.9	.2
Race:			
White	2,200	1.1	.05
Black	(1)	—	—
American Indian	(2)	4.9	5.3
Asian	200	1.7	.3
Other	(2)	3.4	2.3
No report	200	1.3	.2

[1] No cases reported.
[2] Less than 50.
Note: Detail may not add to total because of rounding. Estimates are rounded to nearest 100. Percentages are calculated on unrounded data.
Source: National Science Foundation, Manpower Characteristics System.

[9] Unemployment rates for scientists and engineers developed by the Foundation are composites developed from seven different surveys and data sources. The error ranges shown are not the "standard errors" normally used to measure sampling reliability. These serve, rather, as proxies for the estimated standard error.

[10] National Science Foundation, *Detailed Statistical Tables. Characteristics of Doctoral Scientists and Engineers in the United States, 1973* (NSF 75-312-A) (Washington, D.C. 20550, 1975).

[11] In 1975 the unemployment rate among female doctoral scientists and engineers was 3.0 percent; for males it was 0.8 percent.

[12] Department of Labor, Bureau of Labor Statistics, *Employment and Earnings, December 1976*, Vol. 23, No. 6 (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office).

[13] National Science Foundation, *Detailed Statistical Tables. Characteristics of Doctoral Scientists and Engineers in the United States, 1973, op. cit.*

The reported unemployment rate for female doctoral scientists and engineers is twice that reported for all female scientists and engineers regardless of degree level. This may be somewhat surprising since unemployment generally is inversely related to educational attainment. Of some interest is the fact that almost one-third of those doctoral-level females reported as unemployed were between the ages of 30 and 34, the age where family responsibilities may peak; for men, 22 percent were in the 30 to 34 age group.[14] Furthermore, there is some speculation that those holding the Ph.D. identify with a particular field of science and frequently consider themselves "in the labor force" and seeking employment even though they have not taken any specific action to look for employment, or are available for employment only under a fairly narrow range of conditions. If some of the females reported as unemployed have strong location preference—because, for example, of the presence of a husband who may be considered the primary wage earner, or if they have young children and satisfactory child-care arrangements can not be found—the "meaning" of the reported unemployment is subject to differing interpretations. The surveys upon which the unemployment rates are developed do not ask respondents to specify what they had done to seek employment, or under what conditions—hours, salary, location, etc.—they would accept employment.

In addition, the reported unemployment rate for all female scientists and engineers is based on standard labor market analyses and treats new entrants to the labor force who hold less than the Ph.D. in science and engineering and who are not employed, as outside the S/E labor force. Thus, a person (1) who holds less than the Ph.D., (2) who has never worked as a scientist or engineer, and (3) who is unemployed, is not tabulated as an unemployed scientist or engineer. Generally, occupational unemployment rates developed by the Labor Department (and NSF) relate to the last job of the unemployed. However, a "new" Ph.D. is considered part of the Ph.D. S/E population, and may be tabulated as an unemployed scientist or engineer.

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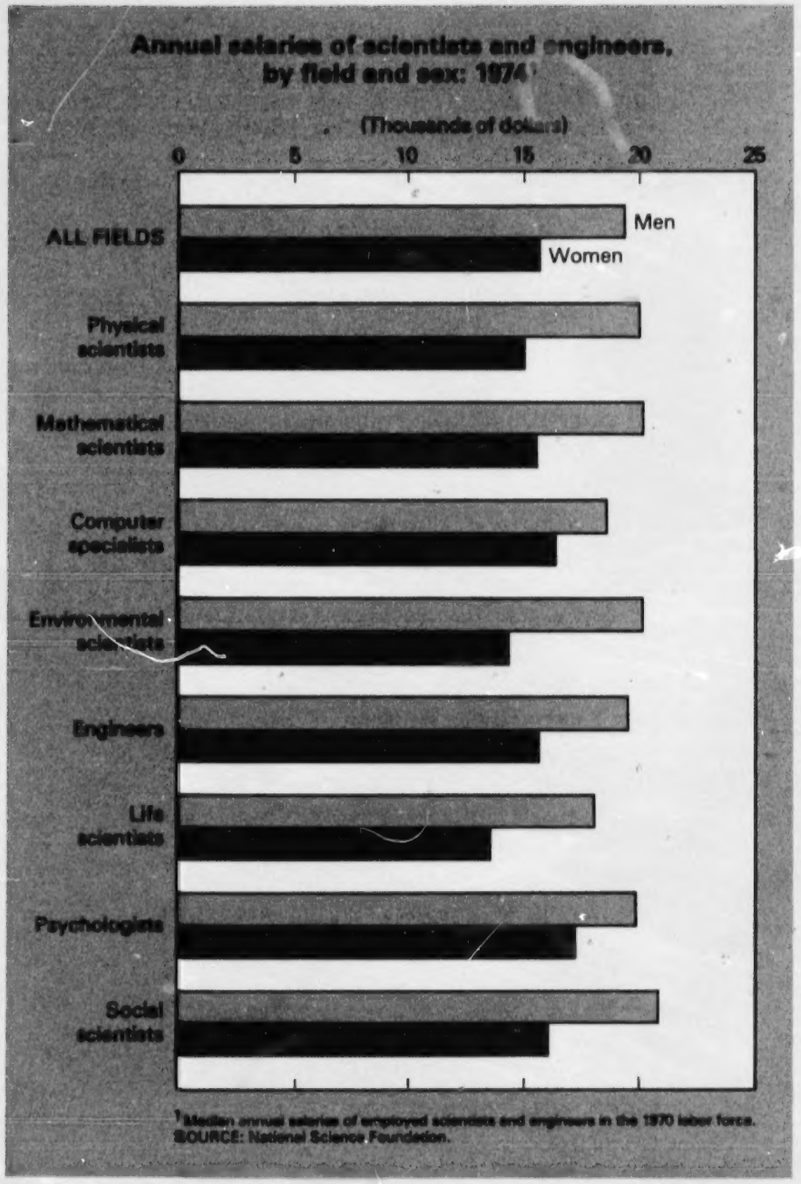
[14] National Academy of Sciences, *Doctoral Scientists and Engineers in the United States. 1973 Profile* (Washington, D.C. 20418, March 1974).



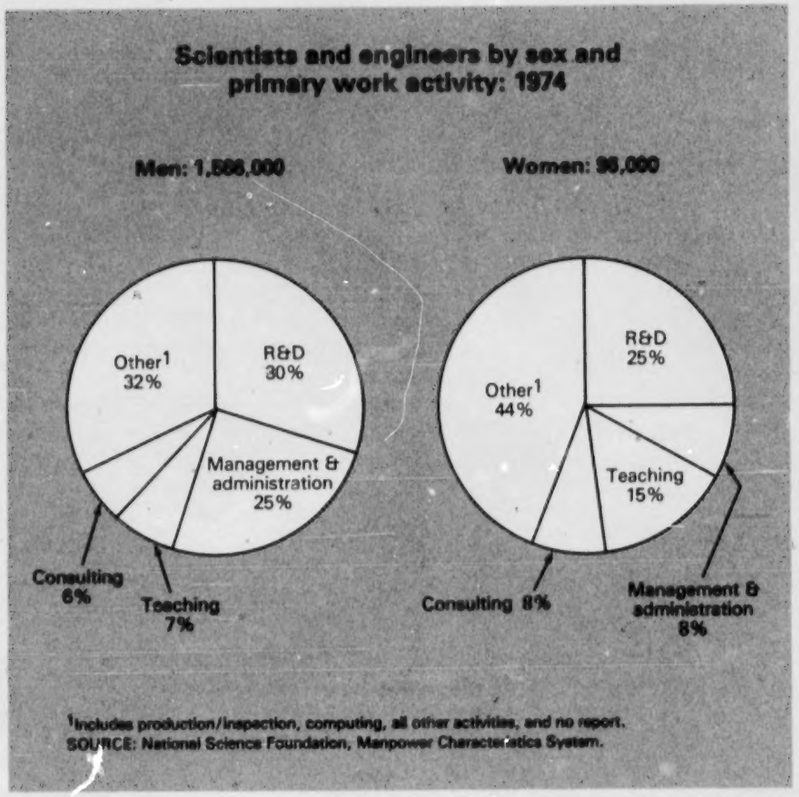
Salaries

Data developed by the Foundation indicate that women scientists and engineers have lower annual salaries than males. In 1974 the median annual salary for males was $19,400; for women, $15,700. The salary differential between men and women varies considerably among fields, ranging from a difference of $2,300 for computer specialists to a difference of $5,800 for medical scientists. Salary differentials reflect many variables including type of employer, age, work activity, and years of work experience. Thus, for example, the median age for males was 42 years and for women it was 35 years. In addition, a greater proportion of men than women were engaged in management and administration, the work activity generally paying the highest salary. Also, relatively more women than men were in the life sciences, and life scientists of either sex received salaries lower than the overall median for all scientists and engineers.

Median annual salaries of the 1970 science/engineering labor force, by field, type of employer, and work activity: 1974

Field	Total	Type of employer			Work activity		
		Business & industry	University & 4-year college	Federal Government	R&D	Management or administration	Teaching
Total	$19,300	$19,000	$19,400	$21,700	$18,400	$22,600	$19,200
Physical scientists	19,500	19,700	18,700	21,700	19,000	24,500	19,000
Mathematical scientists	19,800	20,700	19,400	21,700	21,400	24,200	18,000
Computer specialists	18,400	18,200	17,000	20,900	19,100	20,700	18,900
Environmental scientists	20,100	20,200	19,300	21,400	20,100	22,900	18,900
Engineers	19,400	19,000	20,800	22,300	18,300	22,600	20,400
Life scientists	17,800	18,300	19,200	17,700	17,900	19,000	18,500
Psychologists	19,400	19,600	19,300	22,700	19,500	22,200	18,700
Social scientists	20,200	24,300	20,100	24,600	20,200	23,100	19,800

Source: National Science Foundation, Manpower Characteristics System.



Among doctoral scientists and engineers, women had lower overall salaries than men in 1973. For example, for all fields combined men had annual salaries of $21,200. The comparable figure for women was $17,600.[15] This same general pattern shows across all occupations, and across types of employer and work activity. Salary differentials by race are more mixed. Thus, Black scientists and engineers had slightly higher median salaries than did Whites ($21,000), primarily because of the relatively higher salaries of Black social scientists, psychologists, and engineers.

Asians ($20,000) and other racial minorities ($18,500) generally had lower salaries than White or Black scientists and engineers. Asian mathematical scientists, however, had annual salaries ($20,100) slightly above those for Whites ($19,300), but slightly less than those for Blacks ($20,700).

[15] In 1975 the median annual salary for men was about $23,400; for women, about $19,100.

Median annual salaries of total and female doctoral scientists and engineers, by selected employer and work activity: 1973

Employer and work activity	Total[1]	Females
Total	$20,900	$17,600
Type of employer:		
Business and industry	23,400	19,700
Educational institutions	19,300	17,100
Federal Government	23,700	22,100
Work activity:		
R&D	20,600	17,400
Management and administration[2]	26,700	22,300
Teaching	18,900	17,000

[1] Males and females combined.
[2] Includes the management and administration of R&D.
Source: National Science Foundation, Manpower Characteristics System.

National average monthly[1] salary offers, bachelor's degree candidates, by curriculum and sex: 1973-76

Curriculum	Men			Women		
	Average offer			Average offer		
	1973-74	1974-75	1975-76	1973-74	1974-75	1975-76
Business:						
Accounting	$925	$980	$1,017	$923	$984	$1,021
Business-general	809	847	876	756	822	860
Marketing	782	810	853	721	772	814
Humanities and social sciences:						
Humanities	728	759	816	655	686	743
Social sciences	766	803	866	696	725	770
Engineering:						
Aeronautical	960	1,074	1,152	994	1,071	1,178
Chemical	1,042	1,196	1,278	1,033	1,197	1,283
Civil	697	1,064	1,104	971	1,098	1,153
Electrical	986	1,080	1,154	1,001	1,116	1,175
Industrial	978	1,079	1,137	1,015	1,089	1,164
Mechanical	1,001	1,122	1,195	1,004	1,128	1,226
Metallurgical	1,003	1,134	1,212	1,015	1,089	1,210
Science:						
Agricultural	789	817	856	728	781	826
Biological	751	800	820	664	736	795
Chemistry	891	962	1,011	867	944	1,052
Computer science	920	977	1,035	895	971	1,045
Health professions	727	868	883	734	789	825
Mathematics	878	924	992	871	906	982
Other physical and earth sciences	898	1,012	1,053	878	901	1,043

[1] Monthly offer times 12 equals annual salary offer.
Source: The College Placement Council, *Salary Survey*, Final Report, July 1975, and July 1976.

Starting Salaries

Data from the College Placement Council indicate that the gap in starting salaries for women and minority scientists and engineers may be narrowing. For example, the average offer to men in the biological sciences was $9,840 per year in 1976, 2.5 percent above 1975. For women, the average offer in 1975 was $9,540, an increase of almost 8 percent over 1974.[16]

A similar trend can be seen among doctoral scientists and engineers. For those under 30 years of age, females had salaries about 10 percent below those for males. For all age groups, the difference was approximately 17 percent.

Because of the relatively small number of women scientists and engineers, their younger median age, and the narrowing of the gap in starting salaries between men and women, the differential in average salaries paid men and women in science and engineering is likely to be reduced in the future.

[16] The College Placement Council, *Salary Survey*. Final report, July 1976. (Bethlehem, Pa.)

Conclusions

The available data indicate that there are relatively few women scientists and even fewer engineers, and considerably fewer minority scientists and engineers of either sex. The data also indicate that relatively few women and/or minority scientists and engineers are unemployed.

The data on labor force participation and salary differentials indicate possible problem areas. The labor force participation rate of female scientists and engineers (53 percent) is significantly below the rate for male scientists and engineers (88 percent). The relatively low labor force participation of female scientists and engineers may reflect the personal preferences of these women. It also may indicate an actual or perceived lack of job opportunities. Some female scientists and engineers, no doubt, are out of the labor force because they have become discouraged in looking for employment and think that jobs are not available.

Female doctoral scientists and engineers had lower annual median salaries than did males not only by fields of science, but also by type of employer and by work activity. However, data not currently available—such as years of experience, location preference, publication records, hours devoted to a job, etc—are needed to explain different salary levels before the reason for this can be fully understood. The array of salary data displayed in this report, however, suggests the need for additional study.

The next section of this report moves away from the more traditional labor market analyses and looks at the issue of underutilization of women and minorities in science and engineering from a human resource point of view. Thus, the emphasis in the next section is on such factors as science abilities and the relationship between career plans and career outcomes.

Part II
EXTENT OF UTILIZATION OF WOMEN AND MINORITIES IN SCIENCE AND ENGINEERING

Abilities

WOMEN

Women and men have about the same relative abilities and potential for successful careers in S/E fields. Studies of early childhood abilities disclose that girls perform much like boys in tests believed to be related to potential careers in the sciences; e.g., mathematical and space-relations tests. By the junior high school years, boys' scores begin to exceed those of girls on tests related to science potential.[17] It is during these adolescent years that many young people begin to develop their concepts about future occupations and start to make decisions about courses of study to prepare for occupations. Despite this divergence, however, studies show that by the end of high school there is little difference between the science potential of these young adult men and women. Researchers working with "Project Talent" data, a longitudinal study of high school student cohorts of the sixties, and with data on 1975 high school students, have stated ". . . clearly, the paucity of women in science careers is *not* due to a failure to develop the requisite abilities prior to and during high school."[18]

[17] *Women in Science and Technology*, a Report on a MIT Workshop. Cambridge: MIT Press, May 1973.

[18] *Development of Scientific Careers: The High School Years*, Final Report. Palo Alto, Calif.: American Institutes of Research, Aug. 1976.

MINORITIES

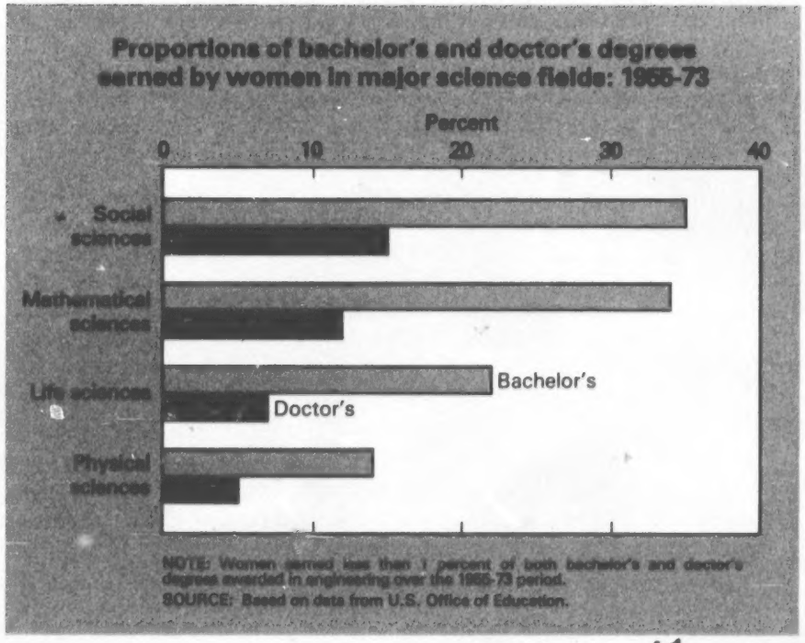
Minorities, however, appear not to have developed the background skills needed for science activities prior to college entry. Important background skills identified included mathematics, reading, and visual imagery skills. In both 1960 and 1975, Black high school students averaged one standard deviation below the mean on scientific potential; their performance on tests of science potential had not improved over the 15-year period. Only 3 percent of the Black students, compared to 15 percent of all students, had scores as high as the mean of those who successfully established careers in science. Almost none of the Black students in the Project Talent (1960) 11th grade sample had jobs in science in 1972-73. Orientals showed science potential similar to that for Whites. The researchers stated that "By and large Blacks and Spanish-surname students have failed to develop the abilities needed for science careers to nearly the degree their White and Oriental peers have."[19]

[19] *Development of Scientific Careers, op. cit.*

Science Majors

During the past two decades, the overall proportion of bachelor's degrees awarded to women ranged from 36 percent in the social sciences to 14 percent in the physical sciences. Among doctor's degrees, the proportions to women were small in all fields, from about 19 percent in the social sciences to around 5 percent in the physical sciences. Since 1965, however, the proportion of S/E degrees at all levels awarded to women has been growing. In 1974 women earned 30 percent of the bachelor's degrees awarded in science and engineering.

Data on the racial composition of those earning doctoral degrees have been collected only for a few years. Similar information for other degree levels will not be available until the results of a 1975-76 survey are available from the U.S. Office of Education. The proportion of doctor's degrees earned by Whites, however, increased between 1974 and 1975. Thus, in 1974 Whites earned about 89 percent of the doctoral degrees in science and engineering awarded to U.S. citizens by American universities. By 1975 the proportion had risen to about 91 percent. For either year there is little deviation from the averages among major fields of science.

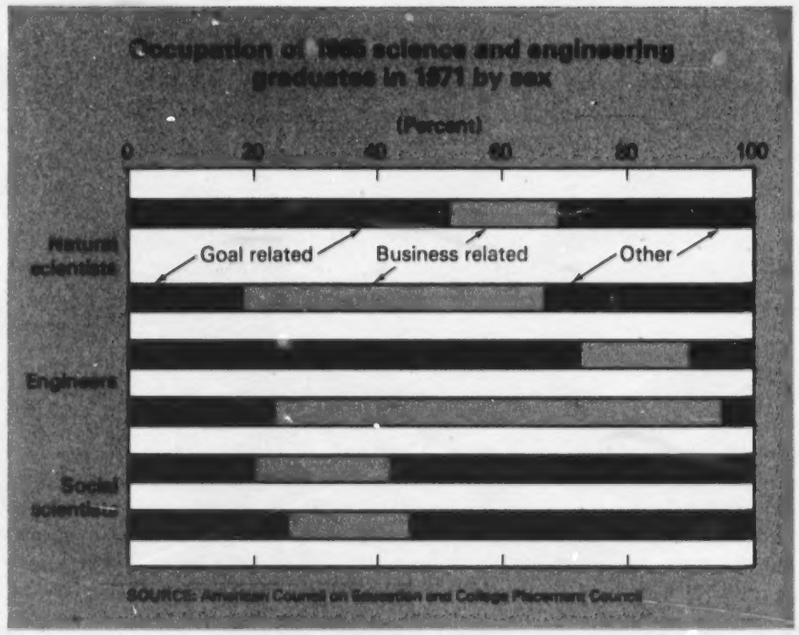


Transition From School to Work

Do the relatively immediate post-educational labor force experiences of men and women with a science education differ? What happens to those men and women who, 4 years after entering college, state that their occupational goal is in engineering or a specific science field?

Data comparing occupational intentions of college seniors in 1965 to actual occupations in 1971 (6 years later) are available from an analysis[20] of data derived from studies supported by the Foundation's Division of Science Resources Studies.[21] Only those persons working full time in 1971 and who had earned at least a bachelor's degree in science or engineering are included in these comparisons; racial data are not available.

For both sexes occupational outcomes differed somewhat from intentions, but for women the differences were greater than for men, sometimes strikingly so. Only 18 percent of the women who planned careers in the natural sciences—life and physical sciences and mathematics—were engaged in their chosen or closely related careers; the comparable figure for men was 51 percent. Almost one-half of the women who originally planned careers in the natural sciences were working 6 years later in business-related occupations, most as computer programmers.



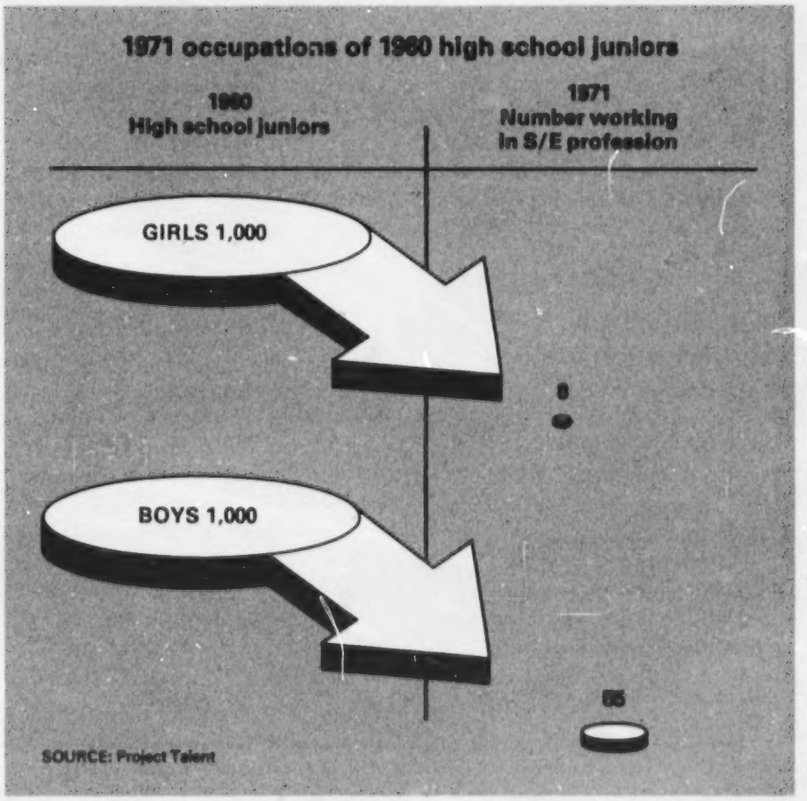
[20] Bisconti, Ann Stouffer and Irene L. Gomberg. *The-Hard-to-Place Majority—A National Study of the Career Outcomes of Liberal Arts Graduates*, Report No. 5. Bethlehem, Pa.: The CPC Foundation, 1975.

[21] "Undergraduate and Graduate Study in Scientific Fields," *American Council on Education Research Reports* 8:3, 1973 and "Five and Ten Years After College Entry," *American Council on Education Research Reports* 9:1, 1974 (Washington, D.C.: American Council on Education.)

In engineering, nearly three-foruths of the men but less than one-fourth of the women who planned in 1965 to enter engineering were employed in engineering 6 years later. Most of the women who did not enter engineering were employed in business-related occupations, chiefly as computer programmers. It appears that women planning careers in science or engineering drift into, choose, or are forced to enter "less prestigious" and probably lower paying occupations relative to their original career choice.

In the social sciences about one-fifth of each sex attained stated or closely related goals. Except for women's traditional occupations like elementary education or social work, this field is the only one in the whole occupational spectrum in which women realize their plans to a greater extent than men. In the social science category, the highest single outcome for women, however, was "other professional," which consisted largely of social workers.

Some measure of the extent to which women are underutilized can be seen from a Project Talent followup study of the professional outcomes of the high school juniors of 1960. Eleven years later, 5.5 percent of the men and only eight-tenths of 1 percent of the women in the cohort were working as S/E professionals, though nearly as many women as men within the group had good science potential.

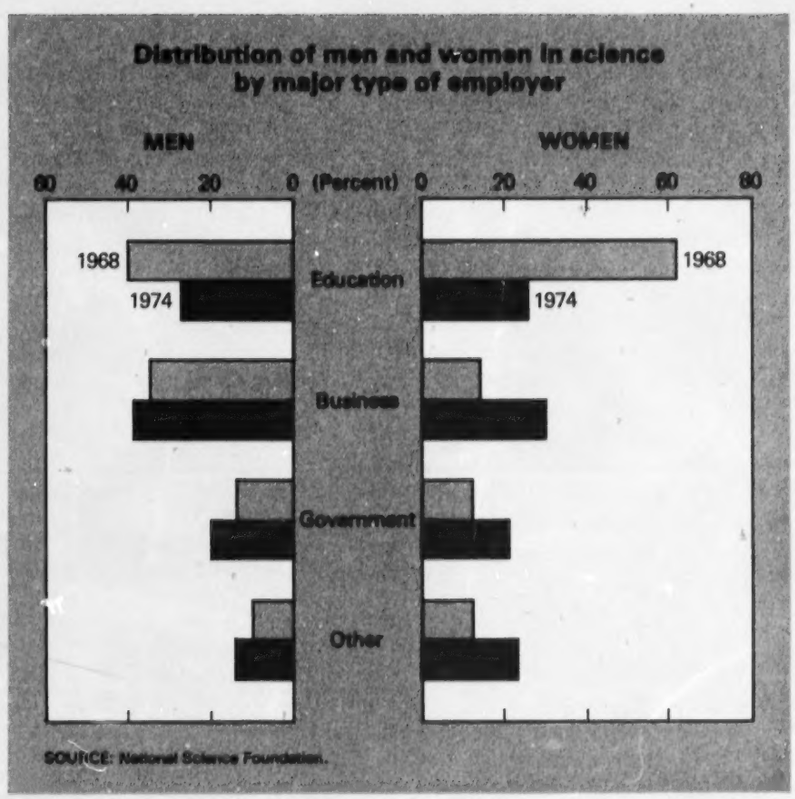


Trends

The proportion of women in the science labor force has increased from 8 percent in 1968 to 14 percent in 1974. In the latter year, by way of comparison, women made up 10 percent of the physician labor force and 7 percent of the legal-judicial labor force. Women, however, represent about 40 percent of all persons in professional and technical occupations. This reflects the large number of professional women employed in women's traditional fields—teaching, nursing, library work, etc.

Long-term historical data are not available on racial composition of the S/E labor force. Available data from NSF, however, indicate there was little change in the racial composition between 1972 and 1974.[22]

Besides the growth of women in the science labor force, another striking difference between 1968 and 1974 is the distribution of women scientists and engineers among types of employers. In 1968, 62 percent of the women scientists were employed by educational institutions, and by 1974, the proportion had declined to 26 percent. There was a similar, though less dramatic, drop for men. The proportion of women working in business and industry more than doubled between 1968 and 1974, and a larger proportion of women were working for Federal, State, and local governments in 1974 than in 1968. During this same period, institutions of higher education were doing relatively little hiring and jobs opened up to women in business and industry.



[22] See, for example, National Science Foundation, *Science Resources Studies Highlights*, "Racial Minorities in the Scientist and Engineer Population," (NSF 75-314), Sept. 19, 1975 (Washington, D.C. 20550).

Conclusions

The data presented indicate that there has been an underutilization of women in the sciences and engineering. The available data and studies do not give specific answers as to why women enter professional science careers to a lesser extent than men, but some inferences can be drawn from the data. First, until very recently, women made up less than one-tenth of the science labor force. Thus, science was not perceived as a field which provided extensive opportunities for women. Second, follow-up data for those high school students in 1960 tested as part of Project Talent show that science-talented women entered occupations such as social work, law, nursing, the teaching of high school mathematics and science, and college English. These outcomes seem highly similar to those of the college senior women of 1965, which were discussed earlier. The experiences of the latter group suggested that women could be most sure of career-goal success if they selected fields traditionally associated with their own sex, such as teaching and social work. And those women who did prepare for and enter S/E professions were more likely than their male counterparts to find themselves working in the academic sector of that field's labor force or in the lower levels of the profession.

With respect to minorities, data indicate that Blacks and Spanish-surnamed persons seemed not to have developed those background skills considered important for careers in science to the same extent as other racial groups and women. This very likely has produced an underutilization in science and engineering of the potential available in the minority groups.

Part III

FUTURE PROSPECTS

Opportunities Ahead

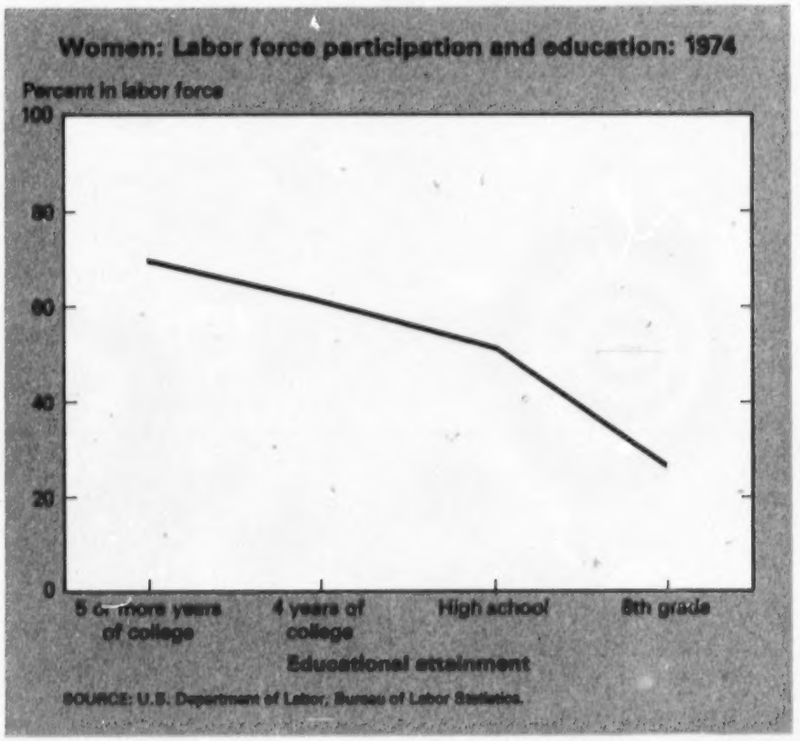
The future is likely to bring greater female participation in science. The NSF recently published projections to 1985 of earned degrees in science and engineering.[23] These projections indicate increasing proportions of women obtaining degrees in science and engineering, and if recent trends in the labor force participation of women continue, the proportion of jobs held by women in science and engineering also will increase.

The prospects for increasing the representation of minorities, especially Black and Spanish-surnamed individuals, in the S/E labor force may not be as favorable as for women. The percentage of these minority high school students in 1975 planning careers in science was only about one-half the percentages of Whites planning science careers. In addition, unlike females, relatively few minorities have developed interests and background skills needed for careers in science prior to college entry.[24]

Researchers have pointed out that in 1975, 10 percent to 15 percent of the ethnic minorities group have developed a plausible minimum level of scientific potential (50 percent of the general population have developed this level). In order to increase the representation of Blacks in science fields, the researchers point out that it will be necessary first to identify this 10 percent to 15 percent. Then, special effort could be made to assist the individuals in this select group who are interested in a career in science to achieve their goals.

Even then, Blacks and Spanish-surnamed individuals are likely to continue to be underrepresented in science until methods are developed to help these minority students develop the needed background skills prior to high school. The barriers which prevent Blacks equal opportunity to enter science careers appear to operate primarily before the high school period.

There is much discussion of the effect of science and technology on society. Equally important is the converse—the effect of society, with its beliefs, its traditions, and its myths, on science and on the development of science and scientists. There have been strong forces in our society unfavorable in subtle and not so subtle ways to the development of science potential, interests, and professional activity among women and minorities. The effect of traditional societal roles has been very strong. Women's and minorities' self-concepts are all-important in determining their career and life goals. The fulfillment of traditional roles for women and professional potential need not be mutually exclusive, however. Increasing numbers of women are pursuing education in the sciences, and generally the more education a woman has, the more she is apt to be in the labor force. To fully utilize the Nation's scientific potential, still further ways need to be found to make young women with high science abilities aware that science careers are open to them and to encourage them to work at their highest level of skill. Additionally, society must develop ways to increase the science potential of racial minorities before the high school years.



[23] National Science Foundation, *Projections of Degrees and Enrollment in Science and Engineering Fields to 1985* (NSF 76-301) (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1976.)

[24] *Development of Scientific Careers*, op. cit.

APPENDIX

Technical Notes

Technical Notes

Data Sources

Unless otherwise indicated, the data for scientists and engineers on employment, unemployment, labor force participation rates, salaries, etc., are from the National Science Foundation's Manpower Characteristics System which was instituted in July 1972 and became fully operable in 1974. The system is made up of three subsystems, each designed to measure the characteristics of a particular subpopulation. Data for doctoral scientists and engineers were obtained by a survey of a sample selected from the Doctoral Roster which is maintained for the Foundation by the National Academy of Sciences. The Census Bureau maintains the National Sample of Scientists and Engineers for the Foundation. This arrangement allows for periodic surveys of a sample of those scientists and engineers who were in the S/E labor force at the time of the 1970 Decennial Census. The third subsystem encompasses the Foundation's New Entrants survey which obtains data for scientists and engineers who are recent college graduates. This subsystem is operated for the Foundation by a private contractor and includes, for this report, new entrants to science and engineering from the graduating classes of 1971, 1972, and 1973.

Generally, the employment and related data presented in this report are based on three sources: the 1973 Survey of Doctoral Scientists and Engineers; the 1974 National Survey of Scientists and Engineers (National Sample); and the 1974 Survey of College-Educated Men and Women (New Entrants Survey).

Information on sample size, estimating procedures, standard errors, etc., for the National Sample can be found in *Characteristics of the National Sample of Scientists and Engineers, 1974, Part 1. Demographic and Education* (NSF 75-333), December 1975. Similar information for the 1973 Survey of Doctoral Scientists and Engineers may be found in *Characteristics of Doctoral Scientists and Engineers in the United States, 1973* (NSF 75-312), May 1975.

Labor Force Participation Rates

In standard labor force analyses, the relevant population or subset of a population is comprised of those who are employed, unemployed, and not in the labor force. The labor force participation rate is merely the ratio of those employed and unemployed divided by the population. That is, $LFPR = \frac{E + U}{P}$ where:

LFPR = Labor Force Participation Rate
E = Employment
U = Unemployment
P = Population (Employed, unemployed, and not in the labor force)

Based on NSF definitions, however, those who earn bachelor's degrees in science and engineering but who have never been employed in science or engineering occupations are not considered part of the S/E labor force. This convention tends to overweight the importance of those not in the labor force when computing labor force participation rates for scientists and engineers.

☆U.S. GOVERNMENT PRINTING OFFICE: 1977—241-314:5

Other Science Resources Publications

REPORTS	NSF. No.	Price
Federal Funds for Research, Development, and Other Scientific Activities, Fiscal Years 1975, 1976, and 1977, Volume XXV	77-301	In press
Detailed Statistical Tables	76-315	—
Detailed Statistical Tables. Federal Support to Universities, Colleges, and Selected Nonprofit Institutions, Fiscal Year 1975	77-303	—
An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1977	76-325	$2.45
Research and Development in Industry, 1974. Funds, 1974; Scientists & Engineers, January 1975	76-322	$2.00
Detailed Statistical Tables. Manpower Resources for Scientific Activities at Universities and Colleges, January 1976	76-321	—
Detailed Statistical Tables. Graduate Science Education: Student Support and Postdoctorals, Fall 1975	76-318	—
Detailed Statistical Tables. Expenditures for Scientific Activities at Universities and Colleges, Fiscal Year 1975	76-316	—
1985 R&D Funding Projection	76-314	$2.10
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R&D Activities of Independent Nonprofit Institutions, 1973	75-308	$1.90
Research and Development in State Government Agencies, Fiscal Years 1972 and 1973	75-303	$1.80
Young and Senior Science and Engineering Faculty, 1974: Support, Research Participation, and Tenure	75-302	$1.70
REVIEWS OF DATA ON SCIENCE RESOURCES		
No. 28. "Scientists and Engineers From Abroad. Trends of the Past Decade (1966-75)"	77-305	In press
No. 27. "Education and Work Activities of Federal Scientific and Technical Personnel, January 1974"	76-308	$0.40
No. 26. "Energy and Energy-Related R&D Activities of Federal Installations and Federally Funded Research and Development Centers. Funds, FY 1973-75 (est.) and Manpower, Jan. 1973-75 (est.)	76-304	$0.35
No. 23. "R&D Expenditures of State Public Institutions, Fiscal Year 1973"	75-311	$0.35
HIGHLIGHTS		
"Graduate Science and Engineering Enrollment Up Only 1 Percent in 1976"	77-302	—
"Employment of Academic Scientists and Engineers Increases 3 Percent in 1976"	76-328	—
"Federal Agencies Allocated Over $4.5 Billion to Universities and Colleges in FY 1975"	76-327	—
"Energy Increase of 18 Percent Paces Industrial R&D Spending in 1975"	76-324	—
"Self-Supported Graduate Science Students Increased by 22 Percent in 1975"	76-320	—
"Academic R&D Spending Up 12 Percent in FY 1975"	76-307	—